Remarks on the Structure and Habits of the Coral-reef Annelid, *Palolo viridis*. By the Rev. THOMAS POWELL, F.L.S., of Upolu, Samoa.

[Abstract, read March 2, 1882.]

THE palolo * vary in length from 1 to 20 inches, and are in diameter from $\frac{1}{10}$ to $\frac{1}{4}$ of an inch. They are of four colours—white, light brown or ochre, greyish indigo, and dark green.

Those of the two former colours are males, and amongst these the darker-coloured varieties are of much greater length, and are also far more abundant than the white or cream-coloured ones. The greyish-indigo and dark-green varieties are females; and of these the dark-green are similarly far longer in measurement and far more abundant than the others.

Whilst watching the living animals under the microscope, I have noticed that the setæ move up and down and backwards and forwards with great rapidity, so as almost to recall to one's mind the motion of the cilia of a rotifer. I observed that this motion was attended by the rapid liberation of the eggs of the female and the sperm of the male, through oviducts and seminal ducts which extend on each side from the centre of the back, between each pair of somites, and terminate on the underside between each pair of lateral appendages. I observed that these ducts are smaller in the male than in the female.

The notion that, in order to effect the liberation of the eggs and of the sperm, the animals break up into small pieces is probably incorrect; for I saw under the microscope, as above narrated, the copious emission of the ova through the oviducts without any breaking-up into parts of the parent annelid. Moreover, on the very last occasion, viz. October 1880, when I had an opportunity of visiting the palolo-ground, I saw great numbers of very long both light and dark palolo (*i. e.* males and females) almost destitute of sperm and ova. These, when caught, broke up into small cyst-like segments, from which the greater part of the contents had apparently already been discharged. Furthermore, when considerable quantities of the worms have been brought to my house in a vessel, and kept a day or two, they have emitted large quantities of eggs and sperm, and yet have not broken up into small portions. That they should be broken up into small portions on the fishing-ground is not to be wondered at, seeing that the sieves are constantly plying. At

* See Trans. Linn. Soc. vol. xxii. p. 237, pl. xli.

the time of spawning the sea becomes discoloured with the eggs for a long way around; and yet there is no corresponding appearance of broken cysts: there are some such cysts to be seen, but nothing comparable to what there should be on the supposition which I am challenging.

That the sight of these annelids is perfect is evident from the way in which a single specimen will endeavour to escape the sieve with which it is the custom to catch them. Often, when seeing a fine single specimen approaching, I have put down my sieve, hoping to take it, but generally in vain; for no sooner has my sieve been put into the water, than the animal has made off rapidly in an opposite direction; and when I have attempted to intercept its flight, it has immediately dodged again and escaped.

The palolo move through the water in different ways: sometimes they are extended nearly at their full length, with but little curvature of their bodies; their progress is then slow. At other times they assume a more serpentine form of progression, and then move more rapidly, and it is by this method of movement that they seek to escape the sieve. In rising from the bottom to the surface, they assume a more spiral form.

The tail of the palolo is furnished with a disk, or with the power of forming itself into one. When examining some specimens under the microscope, in 1876, I observed one fix itself by a circular disk to the plate upon which I had placed it. It remained fast for some little time. On my touching it, it let go its hold and wriggled about; but it soon attached itself again, as before. The circular disk was very conspicuous when thus fixed, but was imperceptible when the animal was free. This power of attachment explains how these worms can remain so long as they generally do concealed among the coral. It may also suggest an explanation of the phenomenon recorded in the 'Samoa Times' of 16th April, 1881, viz. that, on the previous 21st of March, large quantities had appeared on the reef near the village of Gagaemalae, on Savaii—the appearance at such a time, instead of during the month of October, having never before been observed by the oldest inhabitants. The explanation may be this: some unusual local occurrence affecting the reef may have detached the worms from their holding-places, and caused their untimely appearance.

The worms have never been known to appear either at the immediate end of September or beginning of October. No doubt they adhere to the coral, in situations in which they cannot be

seen, till the time of spawning. When the season for this process arrives, they ascend to the surface of the water, inside the lagoon, near the outer reef, often in prodigious numbers; and the natives flock in their canoes, just before daylight, to catch them by dipping them up in sieves of various kinds. (See an interesting account of the scene on such occasions in Seemann's 'Mission to Viti,' pp. 59–61.)

The time of their appearance is the day of the last quartering of the moon in each October, *unless* that fall at the beginning of the month, in which case there will intervene another lunar month. This indicates that the moon exercises some mysterious influence on their reproduction. This, however, is not without analogy in nature, especially in reference to the Crustacea *e. g.*;—it is recorded in Hood's 'Cruise of the Fawn,' p. 127, that in Savaii, "three days before the arrival of the palolo, the malio or land-crabs (*Gecarcinus*) are seen marching down from the mountains to the sea in myriads."

The observations of many years, made by many old European inhabitants as well as by the natives, show that, if from the time of spawning in October we reckon 354 or 355 days, that will bring us to another spawning, unless such reckoning terminate at the end of September or the beginning of October, say from the 1st to the 4th day. In that case the reckoning must extend to 383 or 384 days, when the palolo will appear. Thus, instead of an interval of only twelve lunar months, one of thirteen will occur.

The Rev. G. J. Whitmee has shown, in a paper published in the 'Proceedings of the Zoological Society,' June 1875, that it is probable that this longer interval occurs every third year. The period appears to agree not so much with "solar time," as with the Metonic cycle "of the moon, of 19 years or 235 months, in which time the lunations return (nearly) and begin as they were before."

The natives are generally correct in their calculations as to the time of the appearance of palolo. They take, as the first indication of the approach of the season, the appearance of the scarlet flowers (called Aloalo) of the Gatae (*Erythrina indica*). Then, as a nearer approach, the general budding of the trees, and especially the flowering of the Tavai (*Rhus taitensis*), of the Lagaali (*Aglia edulis*, Asa Gray), and of the Seasea (*Eugenia*, sp.). When this last is in bloom, the men look out for the moon's being just above the western horizon at the dawn of day, and on the

tenth morning from that they look for the appearance of the palolo; but the extra lunar month sometimes puts them wrong. Others watch with equal success, for the indication of the season, the sinking below the horizon of various constellations, commencing with Orion.

I should mention that there is a second appearance of palolo each year, occurring a month after the first, consisting of such worms, probably, as were not sufficiently mature to spawn in October—or, it may be, of another species.

The palolo is by no means confined to Samoa and Viti. Our Samoan missionaries in the Gilbert Group have informed me that they also are found at those atolls. One of the missionaries caught some of both the grey and green varieties there. The worms are found near the outer reefs, in from 4 to 8 feet of water. The natives of the Gilbert Islands hold that the palolo is a production of the coral—grows out of it; they call it "Te Nmatamata," *i.e.* the Glistener. It appears there in *June* and *July*. How is this? Why there in June, but here in October? Perhaps it may be because those atolls are nearly on the line, while Samoa is 14° more to the south.

Samoa, May 14th, 1881.

P.S.—If the above calculations and statements are correct, the palolo should appear in Samoa on October 15th or 16th, 1881, October 5th or 6th, 1882, and October 25th or 26th, 1883.

Observations on British Salmones.—1. Trout.

By Francis Day, F.L.S.

[Read March 16, 1882.]

At the early part of 1880 I exhibited some Salmonidæ before the Linnean Society*, in order to demonstrate how local causes may induce temporary or even permanent changes among members belonging to this family of fishes. The first example I showed was an American charr (*Salmo fontinalis*). The specimen was nine inches in length, of good condition, and with brilliant colours; it had been reared by the late Mr. Frank Buckland in his tanks at the Horticultural Gardens, South Kensington, from eggs received direct from Lake Huron. He presented some of the fry to the authorities of the Westminster Aquarium soon after that institution was first opened; and the example under consideration was the last survivor, having met with its death in October 1879, when

* For brief notice of which see the 'Proceedings' of the Meeting 5th February 1880, p. lii.